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APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE - COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH-CENTRAL ARIZONA

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We are having problems with extraordinary delays in the publication of two abstracts and one significant result in the NTIS Weekly. The two abstracts for papers were sent in early February by I. Lucchitta. A significant result note entitled "Structural Features in the Colorado Plateau Margin Near Flagstaff, Arizona", possibly important to the discovery of new areas for water well drilling for the City of Flagstaff, has not been published in NTIS in spite of the fact that it was forwarded on February 9, 1973. The long delay times in publication are severely hampering our ability to get our results out into the open literature, and to those persons who could best apply our results.

Accomplishments and Plans

Shivwitz Plateau

Snow and mud have again made field operations impossible. Because of this, we have decreased emphasis on fieldwork and devoted the time to the preparation of photogeologic maps of various kinds.

The objectives of the photogeologic studies are:

(1) To provide geologic base data that will be used to achieve the stated geologic objectives of the project.

(2) To determine the best parameters to use in defining photogeologic units.

(3) To determine the amount of map detail that provides a maximum of real geologic information with a minimum of meaningless clutter.

To achieve these objectives, we have prepared the following maps of the Shvwits Plateau area, all on ERTS-1 bases:

(1) 1:1,000,000 map on single-band b&w paper base showing all available detail.

(2) 1:1,000,000 map on a single-band b&w paper base showing subdivision into basin fill, homogeneous basement, foliated basement, layered sedimentary rocks, and lava flows.

(3) 1:1,000,000 map on single-band paper base showing same basic units as (2), but subdivided further wherever warranted by photo information.

(4) 1:400,000 map on single-band b&w paper base is being prepared. This map, which shows all available detail, is intended to help determine whether a larger map scale increases the amount of meaningful geologic information that can be detected and plotted.

Still to be prepared is a photomap at 1:1,000,000 scale based on a three-band color composite paper print. This map will help us understand the special advantages of false-color data in photogeologic mapping at small scales.

Photogeologic lineament maps on ERTS-1 photos at a scale of 1:1,000,000 have been prepared for the Shivwits Plateau and adjacent areas to the west for the purpose of shedding light on the structural transition between the Shivwits Plateau and the Basin and Range provinces. In making the maps, we have experimented with symbology and with the use of Moire screens in bringing out lineament directions.

The careful study of ERTS photos required by the work outlined above has resulted in improved understanding of several geologic features, principally:

(1) The relation of structural trends of the Plateau to those of the Basin and Range Province.

(2) The possible existence of very large lineaments that cross the boundary between the two provinces.

(3) The probable general direction of flow of pre-Colorado River drainages on the Plateau.

(4) The possible continuation of a major pre-Colorado drainage on the Hualapai Plateau. This continuation had been a matter of speculation and debate.

(5) The regional configuration of scarps in the southwestern part of the Colorado Plateau.

(6) The mutual relation of scarps, drainage, and structure.

Two papers and two abstracts incorporating some results from the ERTS investigation have been prepared. The papers are in review, and the abstracts are awaiting release through publication in the NTIS Weekly.

Analysis of the newly received computer processed images will be undertaken in the next reporting period.

Cataract Creek

Field work is slated to begin on May 1. Heavy snowfall has precluded earlier work. Two persons, M. Abrahms and D. Squires, will be mapping there during the summer.

Reconnaissance mapping by M. Foley of Tertiary and Quaternary deposits in the area south and southwest of Seligman, Arizona, indicates that, while direct correlation is not possible, some of the gravels can be related lithologically and genetically with the Robbers Roost, Blue Mountain, and Cataract Creek Gravels mapped by Koons (1948, 1964) on the Eastern Hualapai Plateau. Local outcrops of crystalline rocks may be sources of primary arkosic gravels unrelated to through-flowing Tertiary drainages originating in the Prescott area; provenance studies need to be carefully conducted to avoid misinterpretation of arkosic debris derived from possible crystalline rocks now buried by the Mr. Floyd basalts. Mapping on the Eastern Hualapai Plateau indicates that the Cataract Creek Gravel mapped by Koons in the vicinity of Rose Well is a pediment gravel capping Tertiary sediments including Blue Mountain Gravel. Stratigraphic measurements of the Tertiary section under the Mt. Floyd basalts east of Rose Well indicate by the presence of silts, marls, and lacustrine limestones that a lake occupied the area in late Tertiary time. This lake has been informally designated Hualapai Lake. A revision to Koons' late Tertiary and Quaternary stratigraphy for the Eastern Hualapai Plateau is necessitated by the local and time-transgressive natures of the Robbers Roost and Cataract Creek Gravels. It is suggested that the Robbers Roost Gravel be restricted to pre-through-flowing Tertiary drainage local fanglomerates and talus deposits and not include near-valley-margin facies of Blue Mountain Gravel; that a Frazier Well Formation be established with a Blue Mountain Gravel Member encompassing the arkosic fluvial gravels west of Rose Well and with a Rose Well Member composed of the interbedded fluvial and lacustrine sediments east of Rose Well; and that the Cataract Creek Gravel be dropped unless the designation can be restricted to a meaningful stratigraphic unit.

Central Arizona

Further field work is awaiting the results of the computer enhanced images, in particular ratio images. Field spectrometer work will begin in the next reporting period.

Computer Image Processing

New ratio pictures have been produced which show significant improvement over previous generations. We have demonstrated that the atmospheric scattered component, an additive term, can be removed by measuring the signal level in each band in a cloud shadow and subtracting the value from each pixel. This value is important since it accounts for as much as 10% of the full scale signal in band 4. Three of the possible six ratios can be additively reproduced in a color display. By a proper combination it is possible, for instance, to make vegetation appear blue on a paper print, and the normally red appearing surface rocks, shades of red. This combination is important because the NDPF provided color prints show terrain as well as vegetation in shades of red and brown.

The ratio method will be exploited to the fullest because of the relatively short processing time required, as opposed to the LARSYS classification method. The 360/44 time required for a 1620 x 1620 pixel, or 1/3 ERTS frame, ratio has been reduced to 1.5 minutes.

Future work will be coupled with ground spectrometry in order to find the best possible combination of ratios for maximum discrimination of geologic units.

Data Request Forms

One three-page request for tapes, color prints and nine-inch transparencies was sent on March 27, 1973.